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Identification of Bombyliid Parasites and Hyperparasites of Phalaenidae of the Prairie Provinces of Canada, with Descriptions of Six Other Bombyliid Pupae (Diptera)[1]

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Bombyliid Parasites of Phalaenidae

For many years studies of cutworm bionomics and control, especially of pest species, have been carried on in the Prairie Provinces of Canada. During these studies a number of cutworm parasites and hyperparasites of the bombyliid genera *Poecilanthrax* Osten Sacken, *Villa* Lioy, and *Hemipenthes* Loew have been encountered. These species do not appear to be important factors in the natural control of cutworms, for they cause from two to five per cent of the total parasitism. No detailed data are available on the life-history of any of the species.

Two different groups of Phalaenidae are attacked by these parasites. *Euxoa ochrogaster* (Guen.), *Euxoa tessellata* Harr., and *Agrotis orthogonia* Morr. lay eggs in August and September, overwinter as eggs, are in the larval stage during May and June, and are in the pupal stage during July and August. *Feltia ducens* Wlk., *Chorizagrotis thanatalogia* Dyar, *Euxoa flavicollis* Sm., *Crymodes devastator* Brace, and *Agrotis c-nigrum* L. lay eggs in August and September, overwinter as larvae, and are in the pupal stage during July and August. The parasitic bombyliids are on the wing during the latter half of July and in August and September; the larvae appear to attack the phalaenid larvae in May and June, when the caterpillars are in the fourth, fifth, or sixth instar; and the adults emerge from the host pupae in July and August. It appears therefore that the bombyliids overwinter in the egg stage in the soil or on old vegetation.

In each species studied only one larval skin was found in the host pupa, and this appeared to be that of the mature larva. It is not known where the maggots of the earlier instars live. Extensive soil sifting by officers of the Saskatoon laboratory in a variety of habitats over a period of 15 years has not revealed larvae of these bombyliids, nor have they been observed externally on cutworm larvae.

The species of *Hemipenthes* Loew are generally considered hyperparasites. Of these, in the specimens examined, only one larval skin was found in the primary parasite, and none were found in the cutworm host, so that it appears unlikely that the species can be considered true secondary parasites.

The morphological characters of the larvae and of the pupae have been based upon cast skins of reared material. The material was obtained through the kindness of Dr. J. H. Pepper, Montana State Entomologist, Bozeman; from the Field Crop Insect laboratories at Lethbridge, Alberta, Saskatoon, Saskatchewan, and Brandon, Manitoba; and from the Canadian National Collection, Ottawa. The host records were supplied by Dr. H. McDonald of the Saskatoon laboratory.

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Distributions and Hosts of the Prairie Species

The following information on the distributions of the species was taken from field-collected specimens in the Canadian National Collection.

***Poecilanthrax tegminipennis* (Say)**

Anthrax tegminipennis Say, 1824, Rept. Second Long Expedition 2, App. p. 371.

Distribution.—Manitoba: Aweme, July 27; Onah, August 1; Westbourne, July 27. Saskatchewan: Rosthern, July 2; Saskatoon, July 15; Earl Grey, August 2; Indian Head, August 1; Abernethy, August 13; Estevan, August 5. Alberta: Lethbridge, July 17; Waterton, August 29.

This species is also known from Quebec and Ontario.

Hosts.—*Agrotis c-nigrum* L., *Euxoa flavicollis* Sm.; host larvae collected in May and June.

***Poecilanthrax sackenii* (Coquillett)**

Anthrax tegminipennis var. *sackenii* Coq., 1887, Trans. Am. Ent. Soc. 14: 180.

Distribution.—Saskatchewan: Saskatoon, August 6; Davidson, August 21. Alberta: Lethbridge, August 30; Milk River, July 20; Chin, July 24.

This species is also known from British Columbia (Oliver, Jesmond, Vernon, Penticton).

Hosts.—*Crymodes devastator* Brace, *Agrotis orthogonia* Morr.; host larvae collected in June.

***Poecilanthrax alcyon* (Say)**

Anthrax alcyon Say, 1824, Rept. Second Long Expedition 2, App. p. 371.

Distribution.—Manitoba: Aweme, September 1; Victoria Beach, August 6; Westbourne, August 15; Brandon, August 4. Saskatchewan: Plunkett, August 29; Saskatoon, July 3 to August 29; Earl Grey, September 7; Lemberg, July 26. Alberta: Lethbridge, August 18; Brooks, August 25.

Hosts.—*Euxoa ochrogaster* (Guen.), *Euxoa flavicollis* Sm., *Chorizagrotis thanatalogia* Dyar, *Leucania unipuncta* (Haw.); host larvae collected in the fourth, fifth, and sixth instars in May and June.

***Poecilanthrax willistonii* (Coquillett)**

Anthrax willistonii Coq., 1887, Trans. Am. Ent. Soc. 14: 181.

Distribution.—Manitoba: Aweme, July 13; Treesbank, August 10. Saskatchewan: Saskatoon, July 15 to September 3; Earl Grey, August 10; Marengo, August 22. Alberta: Orion, August 18; Morrin, August 24; Whitla, August 13; Lethbridge, July 30; Medicine Hat, August 6; Milk River, July 20; Brooks, July 25; Chin, August 23.

This species is also known from British Columbia (Nicola, Penticton, Fitzgerald).

Hosts.—*Euxoa ochrogaster* (Guen.); *Feltia ducens* Wlk., *Euxoa tessellata* Harr., *Chorizagrotis thanatalogia* Dyar, *Euxoa flavicollis* Sm., *Crymodes devastator* Brace, *Agroperina dubitans* Wlk.; host larvae collected in the fourth, fifth, and sixth instars in May and June.

***Villa handfordi* Curran**

Villa handfordi Curr., 1935, Am. Mus. Novit. 812: 1.

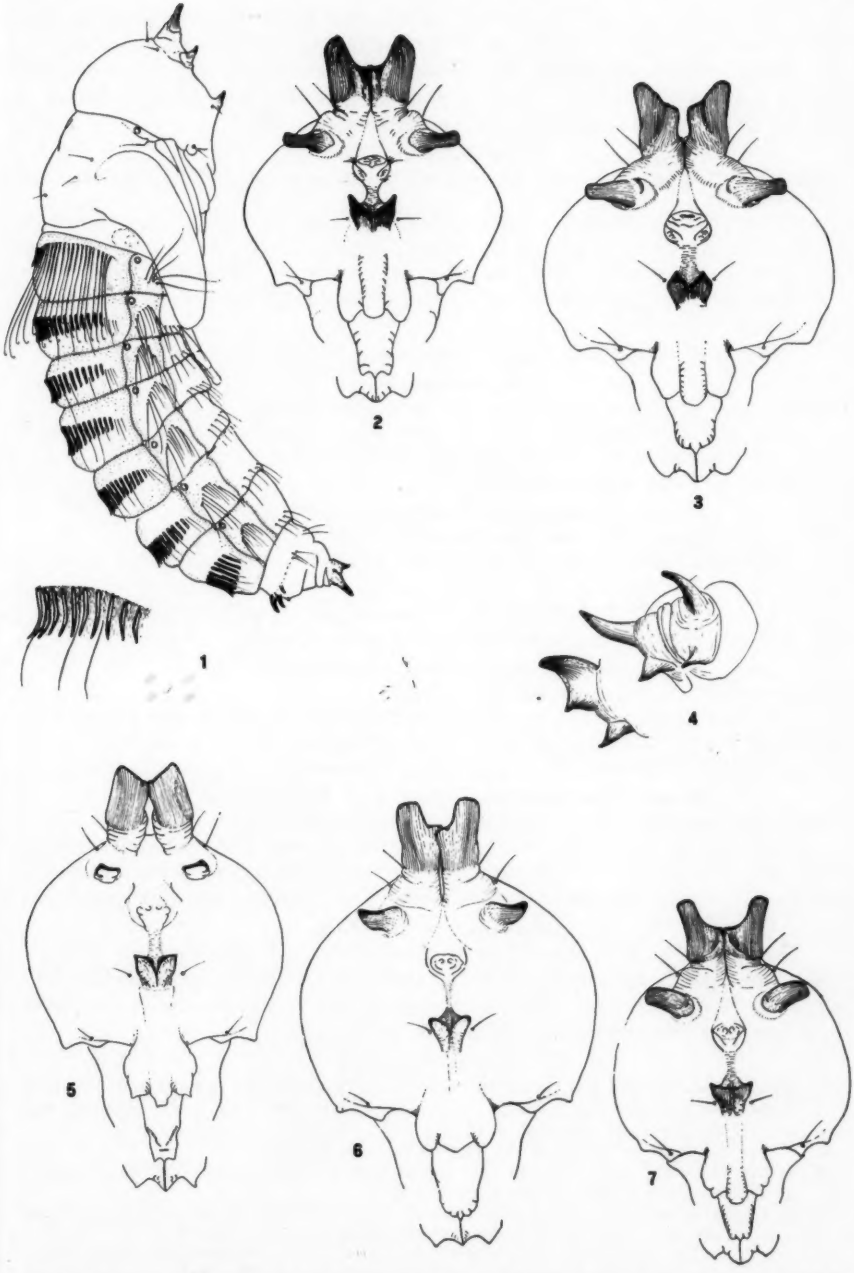
Distribution.—Manitoba: Aweme.

Host.—*Agrotis vetusta* Wlk.

***Villa alternata* (Say)**

Anthrax alternata Say, 1823, J. Acad. Nat. Sci. Philadelphia 3: 45.

Distribution.—Manitoba: Aweme, July 28 to August 1. Saskatchewan: Saskatoon, July 21 to August 21; Plunkett, September 16. Alberta: Cowley, September 10.



Figs. 1-7. *Villa* spp. 1, *V. alternata*. Pupa, lateral view, with enlargement showing detail of dorsal armature of seventh abdominal segment. 2, 3, 5-7, *Villa* spp. Heads of pupae, frontal view. 2, *Villa* sp.; 3, *V. handfordi*; 5, *V. fulviana*; 6, *V. alternata*; 7, *V. molitor*. 4, *V. alternata*. Apical segment of pupa, postero-lateral view showing variations in tubercles.

This species probably has a wide distribution in the Prairie Provinces, as it is known from many localities in British Columbia, Ontario, and Quebec.

Hosts.—*Euxoa flavicollis* Sm., *Euxoa tessellata* Harr., *Agrotis orthogonia* Morr., *Feltia ducens* Wlk., *Euxoa ochrogaster* (Guen.); host larvae collected in the fourth, fifth, and sixth instars in May and June.

Villa fulviana (Say)

Anthrax fulvianus Say, 1824, Rept. Second Long Expedition 2, App. p. 372. (1859 complete works 1: 253)

Distribution.—Manitoba: Aweme, July 27; Melita, August 3. Saskatchewan: Saskatoon, July 26 to August 3; Earl Grey, August 21; Regina, August 8; Abernethy, July 8. Alberta: Medicine Hat, September 13; Waterton, July 29.

This species is also known from British Columbia (Nicola, Robson, Victoria, Vernon).

Host.—*Euxoa* sp.; host pupae collected from June 30 to July 12.

Villa molitor (Loew)

Anthrax molitor Lw., 1869, Berliner Ent. Zeit. 13 (Cent. 8, No. 42): 26.

Distribution.—Manitoba: Aweme, June 30. Saskatchewan: Prelate, June 8 to July 19. Alberta: Lethbridge, September 7; Cowley, May 28.

Host.—*Agrotis orthogonia* Morr.

Hemipenthes catulina (Coquillett)

Anthrax catulina Coq., 1894, Trans. Am. Ent. Soc. 21: 100.

The description of the morphological characters of this species is based on specimens reared at Yahk, B.C., April 12, 1940, from *Bessa harveyi* (Tns.), a parasite of the sawfly *Pristiphora* sp. *H. catulina* occurs in the Prairie Provinces and evidence suggests that it attacks other dipterous pupae.

Hemipenthes sinuosa (Wiedemann)

Anthrax sinuosa Wd., 1821, Diptera Exotica, p. 147.

The description of the morphological characters of this species is based on specimens reared at Deadman River, B.C., emerging on April 16, 1948, from *Neodiprion* sp. *H. sinuosa* has a widespread distribution in the Prairie Provinces.

Hemipenthes morioides (Say) and *Hemipenthes* sp.

Anthrax morioides Say, 1823, J. Acad. Nat. Sci. Philadelphia 3: 42.

These species have been reared from *Gonia* spp. and *Bonnetia comta* (Fall.) from phalaenid pupae. *Hemipenthes* sp. has also been reared from *Paraphyto opaca* Coq. puparia collected on a roadside at Swift Current, Sask., in June, 1935.

Identification of Adults

The species in the genera *Poecilanthrax*, *Villa*, and *Hemipenthes* are very difficult to separate from each other, and there are apparently many undescribed species in North America. The names used in this paper, therefore, may have to be changed when the group is revised taxonomically.

Key to Species

A. Pulvilli present; basal half to two-thirds of the wing black, the apical portion contrastingly clear ..... *Hemipenthes* spp.

AA. Pulvilli absent; wings coloured or clear

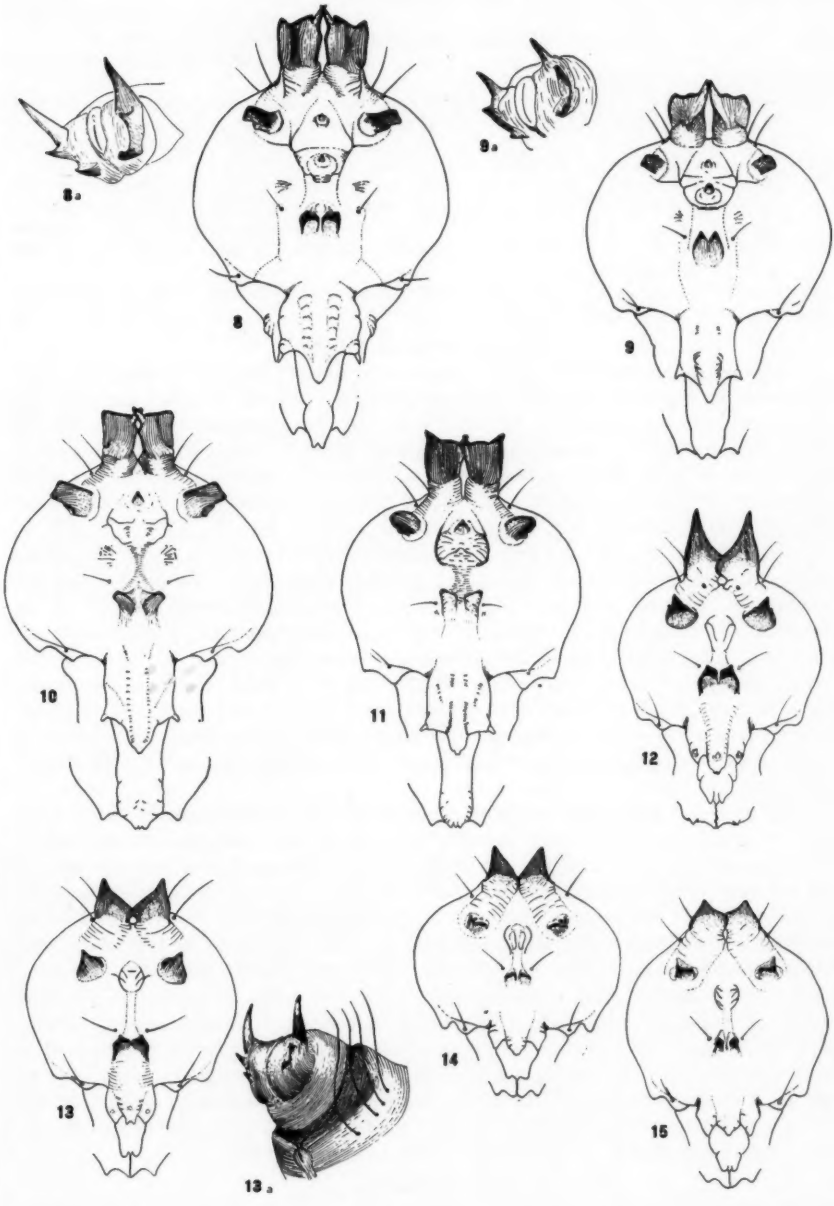
B. Wings darkened or "pictured", at least on the anterior half

C. Wings "pictured", coloured with light and dark areas; third posterior cell usually partly divided by a stump vein or with a closed cell

D. Wing darker with rather small light areas, the light spot in the discal and third posterior cells usually well removed from the posterior margin of the wing (Fig. 38) ..... *Poecilanthrax alcyon* (Say)

DD. Wing lighter with larger light areas, the light spot in the discal and third posterior cells rather extensive and reaching practically to the posterior margin of the wing (Fig. 40) ..... *Poecilanthrax willistonii* (Coq.)

CC. Wing not "pictured", the colour wholly dark, or lighter posteriorly; third posterior cell without a stump vein



Figs. 8-15. *Poecilanthrax* spp. and *Hemipenthes* spp. Heads of pupae, frontal view. 8a, 9a, and 13a, the same. Apical segment of pupa, postero-lateral view. 8, *P. sackenii*; 9, *P. tegminipennis*; 10, *P. willistonii*; 11, *P. alcyon*; 12, *Hemipenthes* sp.; 13, *H. morioides*; 14, *H. sinuosa*; 15, *H. catulina*.

D. Wing wholly dark; thoracic hairs brownish-yellow (Fig. 39) ..... *Poecilanthrax tegminipennis* (Say)

DD. Wing with the posterior half much lighter; thoracic hairs light yellow (Fig. 37) ..... *Poecilanthrax sackenii* (Coq.)

BB. Wings clear, without dark markings

C. Abdominal hair long and wholly yellow, the underlying scales golden or black; most of the scales of the face golden; scales of the enlarged portion of the costal vein mainly golden ..... *Villa fulviana* (Say)

CC. Abdomen with patches or bands of black hair

D. Basal enlargement of costal vein mainly yellow-scaled; body hair light yellow; legs heavily golden-scaled; black hair sparse or absent on the sides of the third abdominal segment ..... *Villa molitor* (Loew)

DD. Basal enlargement of costal vein black-scaled except at the base; legs with many dark scales as well as golden

E. Face with white scales; thoracic hair white except on the humeri ..... *Villa alternata* (Say)

EE. Face with golden scales; thoracic hair pale yellow ..... *Villa handfordi* Cn.

Identification of Pupae

The pupae of the three genera agree very closely in general characteristics, as would be expected in such a group of closely allied species. Generic and specific characters appear to lie mainly in the head region, especially in the degree of development of the various tubercles, though these are slightly variable, and in the lengths of the mouth-parts. The apical segment shows too great uniformity within a group, as well as too great variability within most species (Fig. 4), to be of much use in separating the species.

The various species agree in the following characteristics (Fig. 1). Head bearing three pairs of stout, undivided, pillar-like tubercles, the *cephalic* at the vertex, the *frontal*, and the lower *facial*. Cephalic tubercle tending to be shovel-like, flattened dorso-ventrally, the two close together; frontal tubercle cone- or cylinder-like; facial tubercle small, cone-like; centre of front usually with a shallow, circular depression which may bear small conical or rounded prominences. Four pairs of setae present, two pairs at the vertex, one laterad of the facial tubercle, and one on the lower border of the head just above the front coxae. Mouth-parts short and stout, not reaching beyond the first bend of the foreleg.

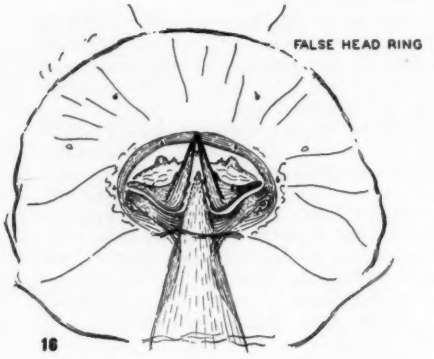
Thorax and wing pads without tubercles; dorsal surface usually with three pairs of fine setae, these being variable in number and strength. Dorsal region of abdominal segment I with 6-10 stout, pointed, recumbent spines medially, a row of very long, curved, hair-like spines laterally; pleural region with a group of 4-8 setae. Dorsal region of each of segments II-VII with one band of stout, pointed, recumbent spines, the spines interspersed with setae in the lateral and dorso-lateral portions of the row; pleural region with a semicircular row of long setae; ventral region with a short row of about six setae on each side. Dorsal region of segment VIII with a group of 2-4 stout, semi-erect spines dorso-laterally on each side, with or without interspersed setae; pleural region with a short row of 2-6 setae; ventral region without setae (female) or with a short row of 2-6 setae (male). Male with a large, bilobed prominence apicad of the setal row; female without large tubercle; apex crowned with 4-6 tubercles, the dorsal tubercles usually long and horn-like, curved dorsally.

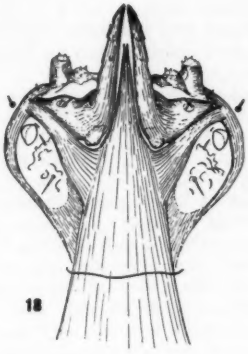
Key to Species

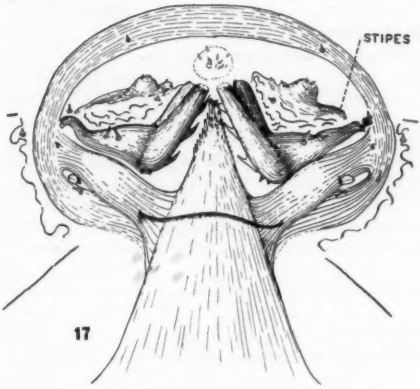
Ventral surface of the eighth abdominal segment with a row of bristles and a large, lobed swelling ..... Males

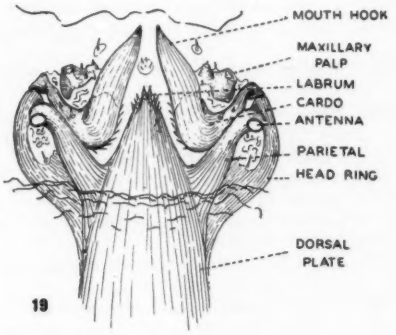
Ventral surface of the eighth abdominal segment without bristles, and the swelling, if present, small ..... Females

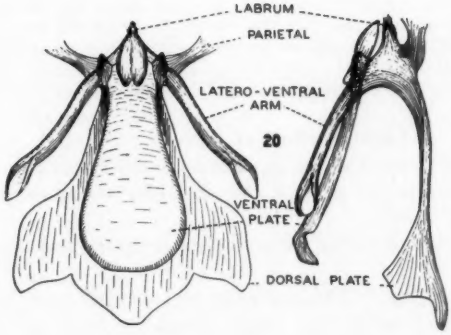
A. Apex of mouth-parts reaching to or beyond the first bend of the front leg; cephalic tubercle with a prominent "finger" medially; eighth abdominal segment with setae as well as spines dorsally ..... *Poecilanthrax* O.S.











Figs. 16-20. *Poecilanthrax* spp., *Hemipenthes* spp., and *Villa* spp. Details of larval head structure. 16-19, anterior head capsule, dorsal view. 20, posterior of head capsule, ventral and lateral views. 16, *P. willistonii*; 17, *P. tegminipennis*; 18, *H. morioides*; 19, *V. alternata*; 20, *P. willistonii*.

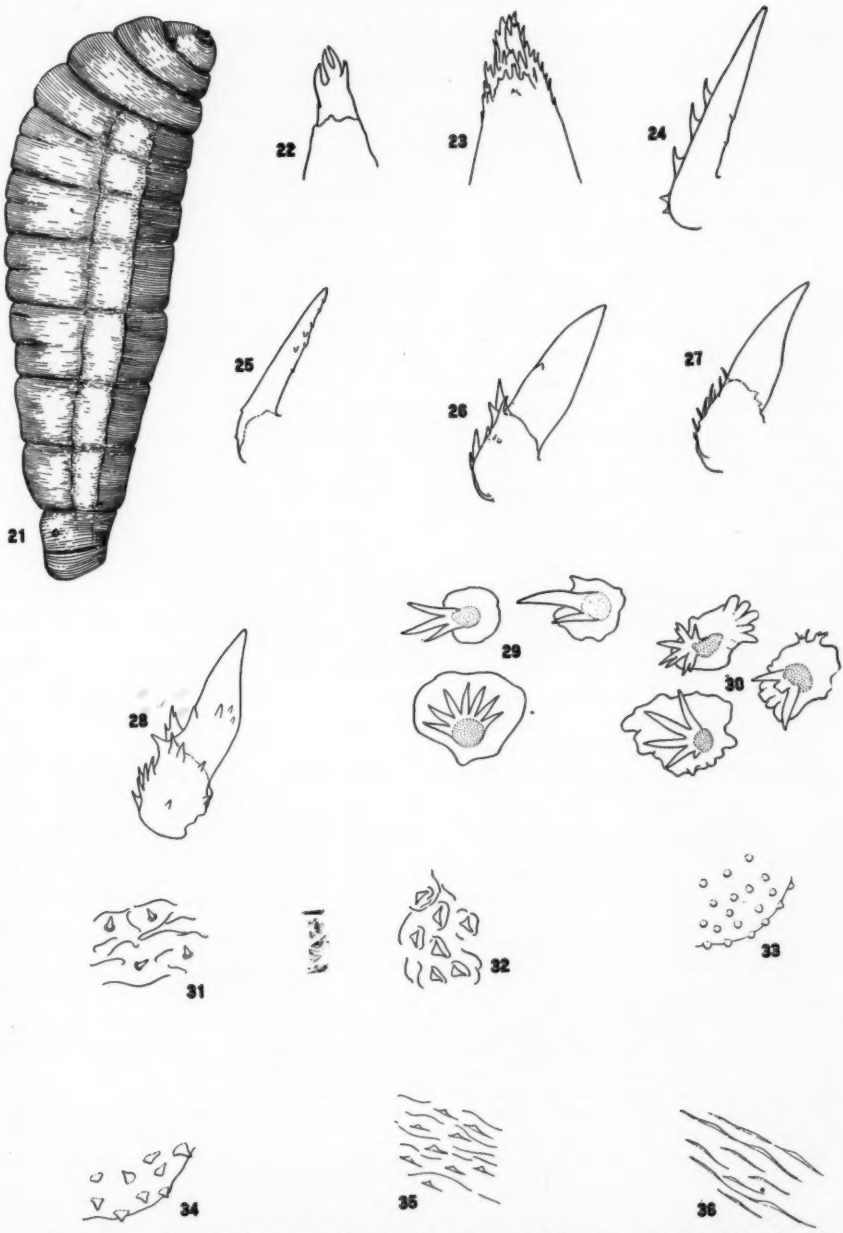
B. Middle of front with two prominences on the median line
C. Cephalic tubercle with a prominent tooth on the lateral corner; tubercles of the apical segment long and stout (Figs. 8, 8a) ..... *P. sackenii* (Coq.)
CC. Cephalic tubercle with the lateral tooth very low; tubercles of the apical segment short and slender (Figs. 9, 9a) ..... *P. tegminipennis* (Say)
BB. Middle of front with one prominence on the median line
C. Cephalic tubercle with a prominent tooth on the lateral corner; frontal tubercle short, rounded apically (Fig. 11) ..... *P. alcyon* (Say)
CC. Cephalic tubercle without the lateral tooth; frontal tubercle long, truncate apically (Fig. 10) ..... *P. willistonii* (Coq.)
AA. Apex of mouth-parts not reaching the first bend of the front leg; cephalic tubercle without a "finger" medially; eighth abdominal segment with or without setae dorsally
B. Spines of the eighth abdominal segment similar to those of other segments, with interspersed setae; cephalic tubercle roughly triangular with the lateral corner elongate; frontal tubercles small and conical or much reduced ..... *Hemipenthes* Loew
C. Labrum and sheath with small tubercles, the three tubercles in practically a transverse row; frontal tubercles well developed, conical
D. Lateral edge of cephalic tubercle very long, giving the tubercle a long, triangular appearance; tubercles of mouth-parts prominent, conical (Fig. 12) ..... *Hemipenthes* sp.
DD. Cephalic tubercle short and squat; tubercles of mouth-parts low and rounded (Fig. 13) *H. morioides* (Say)
CC. Labrum and sheath without tubercles; frontal tubercles reduced
D. Frontal tubercles ridge-like; cephalic tubercle long, triangular (Fig. 14) *H. sinuosa* (Wied.)
DD. Frontal tubercles low, but not ridge-like; cephalic tubercle short, triangular (Fig. 15) *H. catulina* (Coq.)
BB. Spines of the eighth abdominal segment larger, shorter, and more erect than those on the other segments, without interspersed setae; cephalic tubercles more or less truncate with the inner halves usually oblique or hollowed; frontal tubercles usually long and rounded apically ..... *Villa* Lioy
C. Middle of front with a pair of small, rounded, knob-like prominences; front long, the distance between the frontal and the facial tubercles greater than that between the two frontal tubercles
D. Cephalic tubercle oblique-truncate apically, the inner half not hollowed; frontal tubercles small and low (Fig. 5) ..... *V. fulviana* (Say)
DD. Cephalic tubercle hollowed medially; frontal tubercles long and large
E. Cephalic tubercle hollowed on less than the inner third; frontal tubercle with the upper edge concave (Fig. 6) ..... *V. alternata* (Say)
EE. Cephalic tubercle hollowed on more than the inner third; frontal tubercle with the upper edge convex (Fig. 7) ..... *V. molitor* (Loew)
CC. Middle of front without a pair of prominences; front short, the distance between the frontal and the facial tubercles less than the distance between the two frontal tubercles
D. Upper edge of cephalic tubercle oblique and uneven; cephalic tubercles not contiguous (Fig. 3) ..... *V. handfordi* Cn.
DD. Upper edge of cephalic tubercle evenly hollowed; cephalic tubercles contiguous (Fig. 2) *Villa* sp.

Identification of Larvae

Characters for larval determination lie mainly in the structure of the mouth-parts for genera and for species groups; the cuticular armature possesses good characters for individual species.

The terminology adopted in the following descriptions follows that of Berg (1940).

Genus *Poecilanthrax* O.S.: The posterior and ventral parts of the parietal forming a complete, heavy head ring, which bears a number of short sensory setae (Figs. 17, 20); mouth hooks long and conical, with 3-5 well-spaced, flattened spines on the basal half medially; cardo slender, triangular; stipes very narrow and irregular, separated from the cardo by a broad, wrinkled membrane; maxillary palp short, conical, with 4-6 small setae at the apex; ventral sensory organ circular, containing 4-6 pointed and clubbed setae; antennal area rather small, the antenna short, hemispheroidal; labrum with spine-like projections on the apical third to



Figs. 21-36. *Poecilanthrax* spp., *Hemipenthes* spp., and *Villa* spp. Details of larval structures. 21, *P. alcyon*. Larva, lateral view. 22, *P. alcyon*. Labrum. 23, *P. willistonii*. Labrum. 24, *P. willistonii*. Mouth hook. 25, *H. morioides*. Mouth hook. 26, *V. fulviana*. Mouth hook. 27, *V. alternata*. Mouth hook. 28, *V. molitor*. Mouth hook. 29, *V. alternata*. Apical platelets. 30, *V. fulviana*. Apical platelets. 31, *Hemipenthes* sp. 32, *H. morioides*. Cuticular armature. 33, *H. sinuosa*. Cuticular armature. 34, *H. catulina*. Cuticular armature. 35, *P. sackenii*. Cuticular armature. 36, *P. tegminipennis*. Cuticular armature.

half; dorsal plate large, trilobed apically; ventral plate shorter than the dorsal plate, rounded apically, latero-ventral arms tubular, with a prominent knob at the base. Thorax and abdomen without spines; spiracles large, the anterior with 10-13 loops, the posterior with 15-20 loops; cuticular armature consisting of low, flattened, wrinkle-like or spine-like prominences, the apical segment without armature.

Length of *P. alcyon* 15 mm. (Fig. 21); light yellow; integument very thin, semi-transparent; head very small; thorax and abdomen without setae; amphipneustic; posterior spiracles on the penultimate segment.

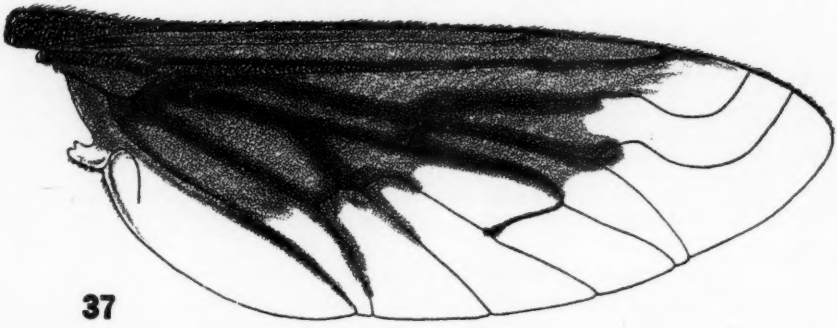
Genus *Villa* Lioy: Head ring incomplete, absent in the ventral region (Fig. 19); mouth hooks lanceolate, somewhat flattened, with a large number of irregularly placed spines on the basal third to half medially; cardo slender, triangular; stipes very narrow and irregular, separated from the cardo by a broad, wrinkled membrane; maxillary palp short, conical, without sensory setae at the apex; ventral sensory organ small and circular, occasionally subdivided into a number of sensory areas; antennal area moderately large, the antenna flat and oval in outline; labrum with spine-like projections on the apical third; posterior part of head capsule similar to that of *Poecilanthrax*. Thorax and abdomen without spines; spiracles large, the anterior with 8-12 loops, the posterior with 15-20 loops; cuticle apparently without armature; apical segment with six dark, spined platelets.

Genus *Hemipenthes* Loew: Head ring incomplete, absent, or very narrowly completed ventrally (Fig. 18); mouth hooks long, conical, with a number of barb-like spines on the apical half; cardo slender, triangular; stipes narrow and irregular, separated from the cardo by a membrane; ventral sensory organ apparently absent; antennal area extensive; antenna short, conical; labrum without spine-like projections except at the apex; posterior part of head capsule similar to that of *Poecilanthrax*. Thorax and abdomen without spines; spiracles small, with 8-12 loops; apical segment without platelets; cuticular armature consisting of hemispheroidal, spine-like, or conical prominences.

Key to Species

A. Head ring complete; mouth hooks spined on the basal third; labrum with a number of spine-like projections on the apical third; apical segment without platelets or prominences; posterior spiracles with 15-20 loops (Figs. 17, 20, 24) ..... *Poecilanthrax* O.S.
B. A false head ring present outside the true head ring; posterior spiracles with 15-16 loops (Fig. 16)
C. Labrum with 4-6 large, single, spine-like projections apically (Fig. 22) ..... *P. alcyon* (Say)
CC. Labrum with a large number of small, branched, spine-like projections apically (Fig. 23) *P. willistonii* (Coq.)
BB. False head ring absent; posterior spiracles with 18-20 loops
C. Body covered with tiny ridges and wrinkles (Fig. 36) ..... *P. tegminipennis* (Say)
CC. Body covered with small, spine-like prominences (Fig. 35) ..... *P. sackenii* (Coq.)
AA. Head ring incomplete, or very narrowly completed ventrally
B. Mouth hooks barbed on the apical two-thirds; labrum with only two spine-like projections at the apex; posterior spiracles with 8-12 loops; apical segment without platelets (Figs. 18, 25) ..... *Hemipenthes* Loew
C. Apical segment without pebble-like prominences; anterior segments with prominences
D. Thoracic segments with broad, triangular prominences dorsally (Fig. 32) *H. morioides* (Say)
DD. Thoracic segments with an armature of spines (Fig. 31) ..... *Hemipenthes* sp.
CC. Apical segment with pebble-like prominences
D. Pebble-like prominences pointed (Fig. 34) ..... *H. catulina* (Coq.)
DD. Pebble-like prominences rounded (Fig. 33) ..... *H. sinuosa* (Wied.)

Figs. 37-40. *Poecilanthrax* spp. Wing patterns. 37, *P. sackenii*; 38, *P. alcyon;* 39, *P. tegminipennis;* 40, *P. willistonii.*



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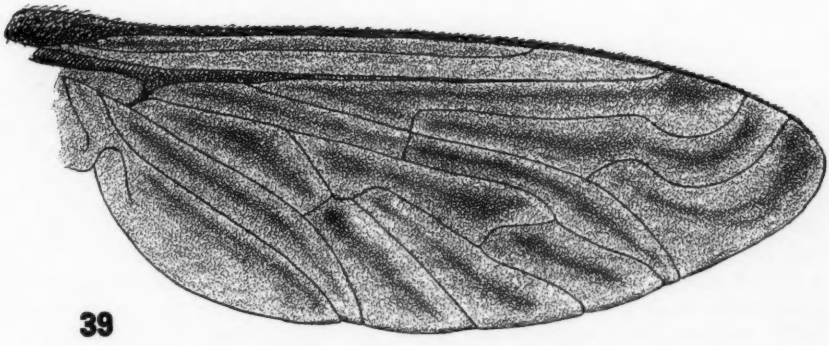

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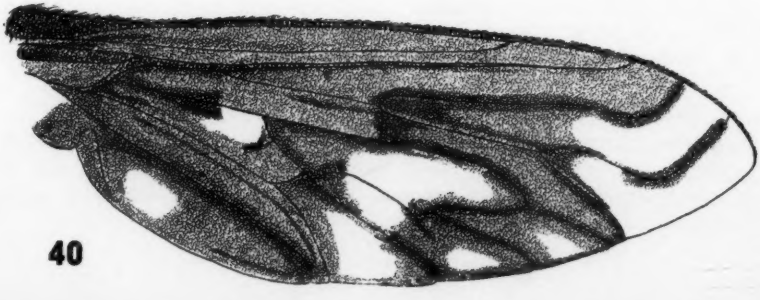

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BB. Mouth hooks barbed or spined on the basal third; labrum with four or more spine-like projections at the apex; posterior spiracles with 15-20 loops (Fig. 19) ..... *Villa* Lioy

C. Apical segment with six dark, spined platelets

D. Ventral sensory organ of the head divided into eight small, round, sensory patches; mouth hooks with stout spines basally; most of the spines of the apical platelets usually branched (Figs. 26, 30) ..... *V. fulviana* (Say)

DD. Ventral sensory organ of the head single; spines of the apical platelets usually single (Fig. 29)

E. Mouth hooks with a few slender spines basally (Fig. 27) ..... *V. alternata* (Say)

EE. Mouth hooks with a large number of stout spines on the basal third (Fig. 28) *V. molitor* (Loew)

Descriptions of Six Other Bombyliid Pupae

The following six descriptions are of bombyliid pupae not obtained from cutworms, but hitherto undescribed (except those of *S. vulgaris* and *A. nitidulus*). In each case, four illustrations of the pupa are included: a, face view of the pupae; b, profile view of the tubercles of the head; c, a view of a representative part of the dorsal cuticular armature of the third abdominal segment; d, a ventro-lateral view of the apical segment.

Lordotus gibbus Loew

Lordotus gibbus Lw., 1863, Berliner Ent. Zeit. 7 (Cent. 4, No. 53): 187.

Medicine Hat, Alta., August 28, 1925. Length 17 mm. Pale yellow with dark tubercles and spines and with bicoloured setae.

Head.—Broad and somewhat flattened; cephalic tubercles widely spaced, somewhat proclinate, ridged, and pointed; frontal tubercle bifid, with an erect, long, pyramidal, dorsal branch and a massive, semi-recumbent, ventro-lateral arm that is turned up and pointed at the apex; facial tubercle absent; middle of front with a depressed line on each side; four pairs of moderately long setae; mouth-parts very long, the labrum coming far below the first bend of the leg and the apex of the haustellum reaching nearly to the apex of the wing (Fig. 41, a, b).

Thorax.—Each wing with a pair of small, pointed, spine-like tubercles at the base; one fine seta above the wing base; prothoracic spiracle large and circular.

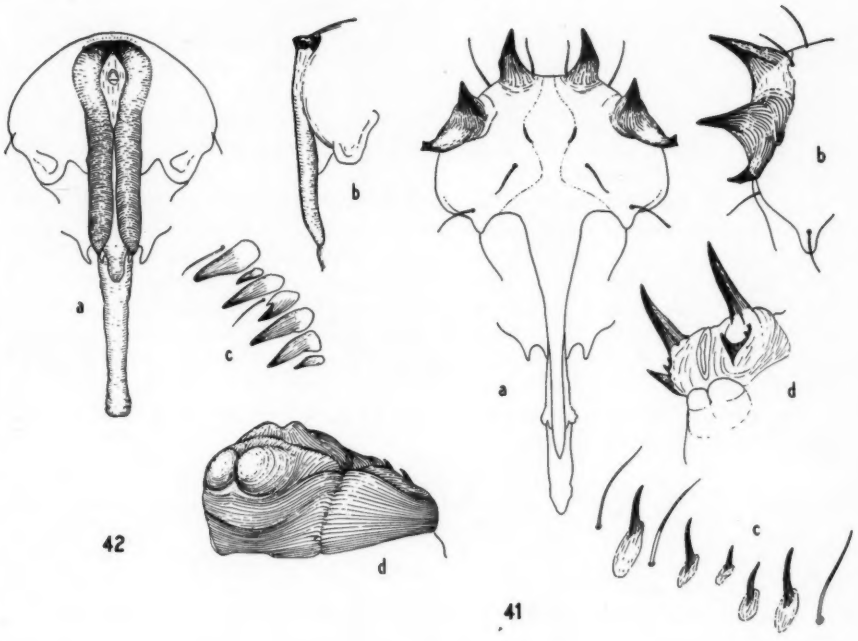
Abdomen.—First segment: median dorsal region bare; latero-dorsal region with a row of three long, stout, curved setae, the setae as long as the length of the segment, their basal halves yellow and the apical halves black; pleural region with three very stout, bicoloured setae. Second to seventh segments: dorsal region with one row of erect spines, each spine on a flattened base (Fig. 41, c); spine row with interspersed, bicoloured setae, the setal row continued nearly to the pleural region and the setae occurring between spines except on the median line; pleural region with a row of six to ten bicoloured setae; ventral region with a row of three to six bicoloured setae on each side; spiracles not as large as the prothoracic spiracle. Eighth segment: basal portion with a row of bicoloured spines encircling the segment; mid-dorsal and latero-dorsal regions with a few spines; mid-ventral region with a pair of spines; apex with a long, curved, dorsal horn, and a moderately long, curved ventral horn (Fig. 41, d).

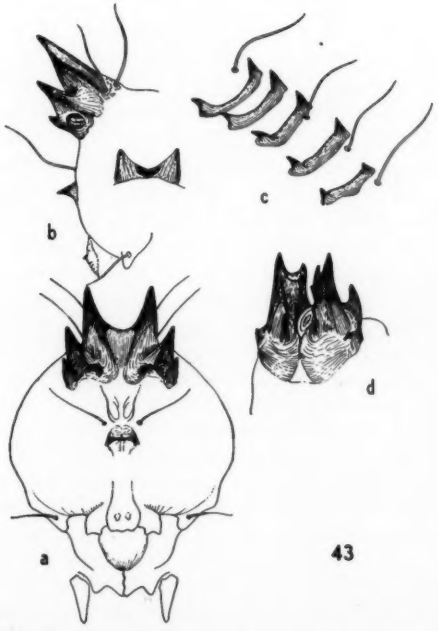
This species keys to *Sparnopolius* and *Anastoechus* in Malloch's (1917) key. The absence of facial tubercles sets it apart from most bombyliids; the allied species *Anastoechus nitidulus* F. sometimes lacks these tubercles.

Systropus macer Loew

Systropus macer Lw., 1863, Berliner Ent. Zeit. 7 (Cent. 4, No. 56): 189.

Specimen reared from *Prolimacodes scapha* Harr. (Lepidoptera: Eucleidae), Cayuga, Ont., emerged April, 1944. Length 7 mm. Pale yellow; the head, thorax, appendages, and apical segment brown. Without tubercles or conspicuous setae.





Figs. 41-43. Pupae of bombyliids. a, head, frontal view; b, head, lateral view; c, abdomen, dorsal armature; d, apical segment, postero-lateral view. 41, *Lordotus gibbus* Lw.; 42, *Systropus macer* Lw.; 43, *Anthrax irrorata* Say.

Head.—Without tubercles or setae; antennal sheaths external, long, reaching nearly to the tip of the labrum, united dorsally on the median line in the form of a low ridge; mouth-parts long, the apex of the labellum reaching practically to the wing tip (Fig. 42, a, b).

Thorax.—Thorax with a hump-backed appearance, dark brown; thorax and appendages without spines, tubercles, or setae; prothoracic spiracles small, rounded, with four or five divisions.

Abdomen.—First segment: dark brown, without spines or setae. Second to seventh segments: chiefly pale yellow; brown on the anterior third in the dorsal region; dorsal region with one row of rather large, triangular spines, each spine slightly upturned at the apex; interspersed setae very slender and short (Fig. 42, c); pleural and ventral regions without setae. Eighth segment: dark brown, the basal portion with a row of spines and setae as in the other segments; apex with a pair of low, rounded prominences; ventral surface without setae (Fig. 42, d).

As this species has no tubercles on the head, it does not fit into Malloch's (1917) family diagnosis or key.

Anthrax irrorata Say

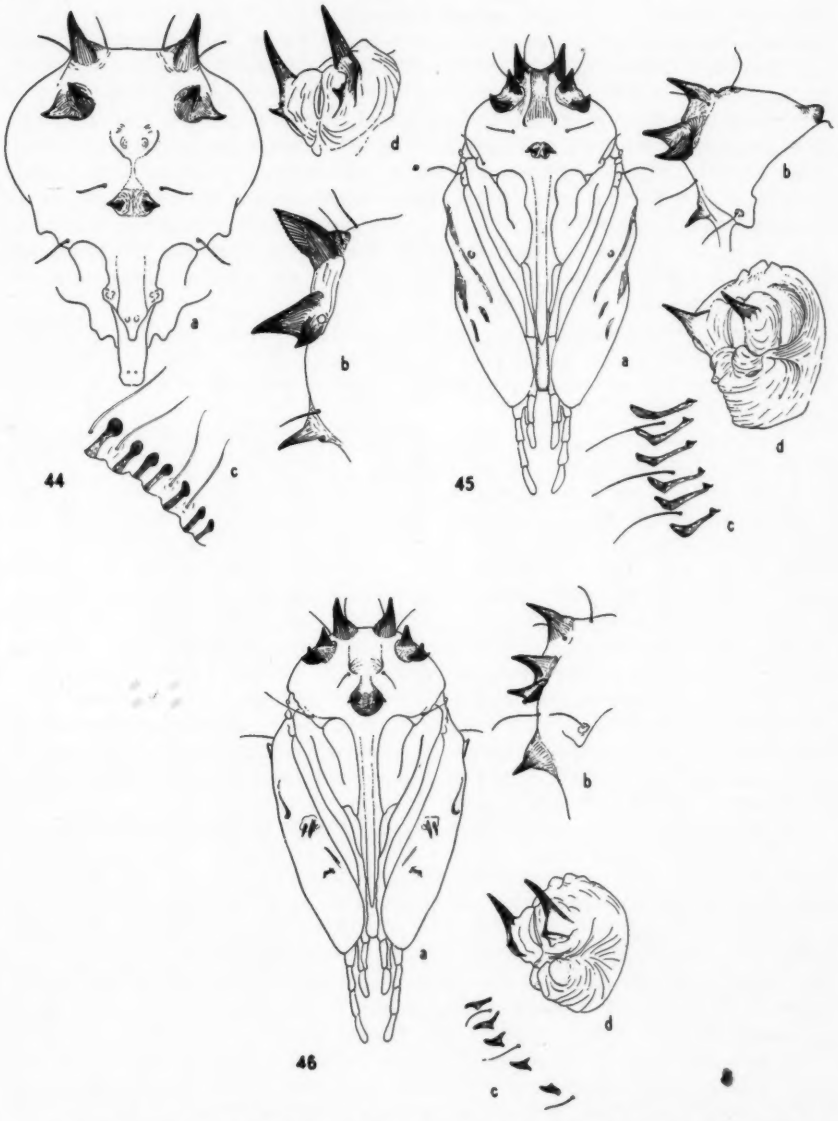
Anthrax irroratus Say, 1823, J. Acad. Nat. Sci. Philadelphia 3: 46. (Complete works 2: 61)

Specimen reared from *Megachile nivalis* Fries (Hymenoptera: Megachilidae), White Fox, Sask., emerged May 1945. Length 11 mm. Light yellow with yellow setae and dark-brown tubercles.

Head.—Cephalic and frontal tubercles united at their bases; frontal tubercle subdivided into a larger dorsal and a small ventral portion, both portions conical; cephalic tubercle pyramidal with triangular base; frontal tubercle with a short palp-like organ projecting from a pit dorso-laterally; facial tubercles flat, triangular, perpendicular to the face, contiguous at their bases; middle of front without prominences or depressions; four pairs of setae, moderately long; labrum with a pair of small, conical tubercles; mouth-parts short and broad; not reaching the first bend of the front leg (Fig. 43, a, b).

Thorax.—Dorsum without tubercles; four pairs of setae, two above the bases of the wings and two dorso-laterally, very close together; wing sheath reaching the tip of the second abdominal segment, without spines or tubercles; prothoracic spiracle round, prominent, with eight divisions.

Abdomen.—First segment: median dorsal region bare; dorso-lateral region with a row of eight to ten long, cylindrical, tapered setae; pleural region with eight to ten long, cylindrical, pale setae similar to those of the dorsal region but each as long as the thorax; ventral region bare. Second to fifth segments: dorsal and dorso-lateral regions with one row of stout, heavy, recumbent spines, the spines with upturned, pointed apices and bases (Fig. 43, c); interspersed setae present except medially, the setal row continuing down to the pleural region; pleural region as in segment one; ventral region with a row of long setae on each side of the bare median line; spiracles similar to the prothoracic spiracle. Sixth and seventh segments: dorsal region without spines, the setal row normal, as in the preceding four segments; pleural and ventral regions similar to those in the preceding segments. Eighth segment: basal portions with a row of long setae on the dorsal and the pleural regions; ventral region bare; apical portion of the segment with a small, flattened, triangular spine on the median dorsal line; apex with a pair of complex tubercles, backwardly directed, each tubercle with a basi-dorsal, a basal ventro-lateral, a subapical dorso-medial, a subapical ventro-medial, a small ventral, and a large apical point (Fig. 43, d).



Figs. 44-46. Pupae of bombyliids. a, head, frontal view; b, head, lateral view; c, abdomen, dorsal armature; d, apical segment, postero-lateral view. 45, *Systoechus vulgaris* Lw.; 46, *Anastoechus nitidulus* F.

The pupa of this species keys to *Spogostylum albofasciatum* in Malloch's (1917) key, but differs most markedly in the shapes of the posterior tubercles, by lacking spines on segments six and seven, and by having all the abdominal setae slender.

Exoprosopa caliptera (Say)

Anthrax caliptera Say, 1823., J. Acad. Nat. Sci. Philadelphia 3: 46. (Complete works 1: 253)

Specimen from Lethbridge, Alta.; host an unidentified parasitic hymenopteron. Length 12 mm. Pale yellow with dark-brown to black tubercles.

Head.—Cephalic tubercles widely spaced, flattened and serrate anteriorly; frontal tubercle bifid, the dorsal branch erect and the ventro-lateral branch curved; facial tubercles separated but on a common prominence, erect, pointed; middle of front with a slight depression, the depression bearing a low, rounded prominence on each side; four pairs of rather short setae present; mouth-parts moderately long, the apex of the labrum nearly reaching the bend of the front leg; labrum with a pair of small prominences near the apex; labellum reaching about half-way to the wing tip (Fig. 44, a. b).

Thorax.—Wing sheath with a small, rounded prominence near the base; four pairs of short setae, two at the base of each wing and two very close together latero-dorsally on each side; prothoracic spiracle moderately large, reniform, with 10-12 divisions.

Abdomen.—First segment: median dorsal region with eight dark, pointed spines flanked latero-dorsally on each side by a row of six long, slender, curved setae, the setae as long as a segment and a half; pleural region with three or four long, slender, curved setae. Second to seventh segments: dorsal region with one row of dark, spatulate spines, each slightly turned up at the apex (Fig. 44, c); interspersed setae long and slender, the row of setae continuing to the pleural region, absent mid-dorsally; setae of posterior segments smaller, more pointed, and more erect than those on the anterior segments; pleural region with a row of long setae; ventral region with a row of long, fine setae on each side, the row being continuous on the seventh segment. Eighth segment: basal portion with a row of small, pointed spines dorsally, the spine row with two or three interspersed setae on each side; pleural region with a row of six to eight long setae; ventral region bare; apical portion with a prominent, mound-like prominence on the median line dorsally; apex with a curved dorsal horn and a short, spine-like ventral horn on each side (Fig. 44, d).

This species keys to *Exoprosopa fascipennis* Say in Malloch's (1917) key.

Systoechus vulgaris (Lw.)

Systoechus vulgaris Lw., 1863, Berliner Ent. Zeit. 7 (Cent. 4, No. 52): 186.

Specimen from Saskatoon, Sask., May 15, 1938, from grasshopper egg pods. Length 8-9 mm. Light yellow with dark tubercles and spines.

Head.—Cephalic tubercles horn-like, widely spaced; frontal tubercle bifid, the dorsal branch erect, the ventral branch semi-erect and with a large, circular, tympanum-like spot below; cephalic and frontal tubercles with long, spine-like continuations at their apices when first formed but these easily broken off and rarely present in field specimens; facial tubercles conical, close together or united basally; middle of front with a depressed line on each side; four pairs of moderately long setae; mouth-parts very long, the labrum reaching far below the first bend of the front leg, the tip of the haustellum reaching nearly to the wing tip; occiput with a pair of large, rounded prominences.

Thorax.—A pair of low, rounded prominences next the occiput dorsally; wing sheath with a small, knob-like prominence near the front margin, about one-third of the length from the base; spiracular prominence conspicuous; three pairs of long setae.

Abdomen.—First segment: dorsal region with one row of spines, the spines with long, attached bases and long erect, pointed apices; interspersed setae dark;

pleural region with a row of four long setae. Second to seventh segments: dorsal region with one row of spines and interspersed setae, the spines upturned at both bases and apices, and smaller on the posterior segments; pleural region with four long setae; ventral region with two long setae on each side except that there are three or four on segment seven. Eighth segment: basal portion with a row of long setae dorsally and pleurally, ventrally bare in the female but with setae in the male; apical portion with three prominences dorsally; apex with one pair of upturned, horn-like tubercles; dorsal prominences larger in the male.

This species is a very common predator of grasshopper egg-pods in the prairies of Canada. Berg described the larval stages in 1940.

Anastoechus nitidulus (F.)

Bombylius nitidulus F., 1794, Ent. Syst. 4: 409.

Specimen from Lethbridge, Alta., August 10, 1921. Length 9-10 mm. Light yellow with dark tubercles and spines.

Head.—Cephalic tubercles horn-like, widely spaced, proclinate; frontal tubercle primarily bifid, the dorsal branch erect and pointed, the ventral branch bifid with longer upper and shorter lower tips; an oval, tympanum-like area on the lower side of the ventral branch of the frontal tubercle; facial tubercles widely spaced, the pair on a prominent elevation common to both; middle of front with a depression on each side; four pairs of setae; mouth-parts very long, the tip of the labellum reaching nearly to the wing apex; occipital region smooth.

Thorax.—Three pairs of fine setae above each wing base; each wing sheath with a low, ridge-like tubercle at the base, a pair of spine-like tubercles near the front margin one-third of the way from the base, and a low, flattened tubercle one-third from apex; spiracle prominent.

Abdomen.—First segment: dorsal region with a row of eight to ten fine setae; pleural region with a row of five or six rather stout, long setae. Second to seventh segments: dorsal region with one row of small, conical spines, the interspersed setae short, the setal row continuing nearly to the pleural region; pleural region with a row of five or six very fine setae; ventral region with a row of five or six setae on each side; spiracles much smaller than the prothoracic spiracle. Eighth segment: basal portion with a row of spines and setae dorsally and pleurally, the ventral region bare (female) or with a row of setae (male); apical portion with a pair of prominences dorsally; apex with a long, curved, dorsal horn and a small, triangular, ventral horn.

This species is a predator of grasshopper egg-pods, especially in southern Saskatchewan and Alberta. It is not so common as *Systoechus vulgaris* Lw. One pupa before me (male) has no facial tubercles.

References

Berg, V. L. 1940. The external morphology of the immature stages of the bee fly *Systoechus vulgaris* Loew (Diptera, Bombyliidae), a predator of grasshopper egg pods. *Canadian Ent.* 72: 169.

Malloch, J. R. 1917. A preliminary classification of Diptera, exclusive of Pupipara, based upon larval and pupal characters, with keys to imagines of certain families. Part I. *Illinois State Lab. Nat. Hist. Bull.* 12: 161-409.

On *Mioctenopsylla* Rothschild, a Genus of Siphonaptera (Ceratophyllidae), with Description of a New Species[1]

By GEORGE P. HOLLAND[2] AND WILLIAM L. JELLISON[3]

The formerly monotypic genus *Mioctenopsylla* Rothschild, 1922, was erected to accommodate an unusual ceratophyllid flea collected from nests of the kittiwake, *Rissa tridactyla* ssp., during the Norwegian Expedition to Novaya Zemlya in 1921. Although it could be assigned to Jordan's "Group C" of *Ceratophyllus* s. lat., this species, described as *M. arctica* Rothschild, differed in many remarkable ways from all other species and genera of the group. The spines of the pronotal ctenidium, large and deeply pigmented in all other Ceratophyllidae, are reduced in *Mioctenopsylla* to short, pale structures that could easily be overlooked (Fig. 7). Other characters of the genus not found elsewhere in the Ceratophyllidae include denticulate dorsal margins to the abdominal terga, numerous minute punctuations on the sterna, and narrow mid- and hind-coxae, as well as distinctive sexual features.

Mioctenopsylla arctica is not well known, and has been recorded only twice in the literature since the original description. *Boreopsyllus hadweni* (Ewing) [originally and erroneously placed in *Amphipsylla* Wagn.] was described from two female specimens collected at Puffin Island*, Alaska, ex Sabine's gull, *Xema sabini* (Sabine), and was later synonymized with *M. arctica* by Jordan (1932, p. 118), who presumably studied the types in 1928 when he visited the United States National Museum at Washington, D.C. Other authors have accepted this synonymy. Kemner (1938) recorded *M. arctica* from Iceland, again from *Rissa tridactyla*.

The recent collection of a large series of fleas belonging to this genus from the nests of kittiwakes on St. Paul Island, Pribilof Islands, Alaska, is therefore of considerable interest. Examination of the material has revealed that two species are represented and indicates further that the question of the synonymy of *M. hadweni* should be reconsidered.

The following material has been available for study:—

(a) The pertinent literature, including the very thorough paper by Rothschild (1922) which is splendidly illustrated by Dr. Jordan.

(b) A pair of paratypes of *M. arctica* (in the Canadian National Collection, Ottawa).

(c) A female of *M. hadweni* with type data but not included in the type series by Ewing (loaned by Colonel Robert Traub).

(d) A collection of 58 ♂ ♂ and 86 ♀ ♀ of *Mioctenopsylla* spp. collected during August and September, 1951, ex nests of *Rissa* spp., St. Paul Island, Alaska, by one of the authors and Dr. O. Wilford Olsen.

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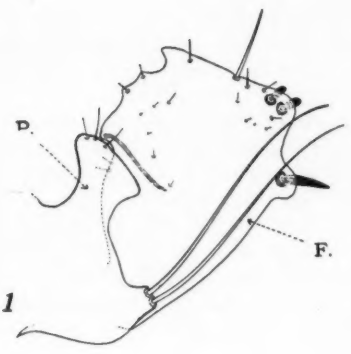
*It has not been possible to discover the exact geographical location of "Puffin Island" as it does not appear on any of the available maps. However, an examination of Dr. Seymour Hadwen's itinerary in Alaska in 1920 indicates that he must have been in the vicinity of Unalakleet during the whole of August. As the specimens were collected on August 6 of that year, we may assume that the island is situated near the head of Norton Sound. The name may well be a local one, and the "island" a mere rock in the sea.

Figs. 1-4. *Mioctenopsylla* spp. 1, *M. arctica arctica* Roths., clasper of male (paratype). 2, *M. arctica hadweni* (Ewing), clasper of male (St. Paul Is., Alaska). 3, *M. traubi* n. sp., clasper and sternum IX of male (holotype). 4, Sternum VII of female: a, b, *M. a arctica* (paratypes); c, *M. a. hadweni* (Puffin Is., Alaska); d, e, *M. a. hadweni* (St. Paul Is., Alaska); f, *M. traubi* (allotype); g, *M. traubi* (paratype).



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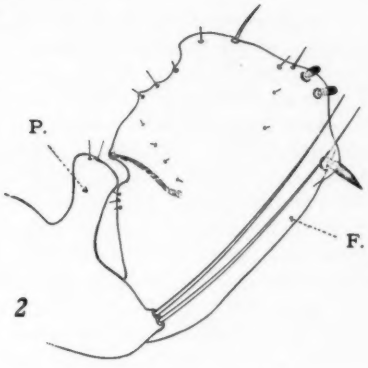

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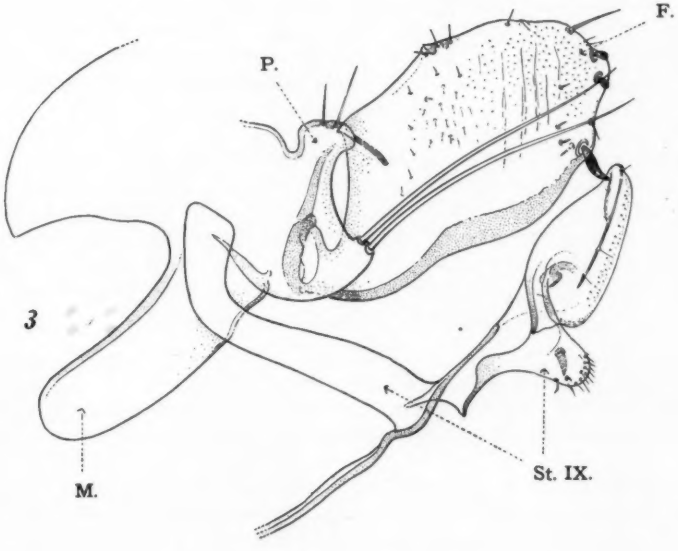

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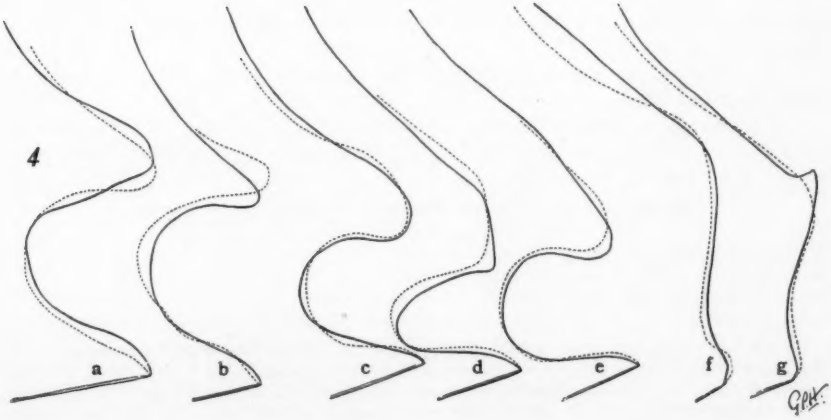

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In addition, Colonel Traub kindly provided information on the type and paratype of *M. hadweni*, which are preserved at the U.S. National Museum, Washington, D.C., and Mr. F. G. A. M. Smit did likewise with the paratypes of *M. arctica* remaining at the Zoological Museum, Tring, England.

As a result of their studies, the writers are of the opinion that the Alaskan representatives of *M. arctica* exhibit small but constant differences, especially in the males, from Novaya Zemlya material that warrant the recognition of a Nearctic subspecies. For this, the name *M. hadweni* is available. The types of *M. hadweni* compare closely with the females of the St. Paul series, and there appears no reason at this time to assume that more than one Nearctic subspecies is represented. The difference in host is probably not significant, many sea-bird fleas being rather casual in their associations. However, the kittiwake may be the primary host, and probably was present on Puffin Island. It is not possible to assess the specimens reported from Iceland.

The second species, represented by only three specimens, was collected in company with *M. arctica hadweni*. No definite opinions can be expressed on its host associations, but the fact that two species of kittiwakes, *Rissa tridactyla pollicaris* Ridgway and *Rissa brevirostris* (Bruch), occur and breed in the Pribiloff Islands may be considered suggestive.

These bird nests were taken from the cliff rocks between Gorbatch and Reef rookeries. They were cold, soggy masses of vegetation and excreta and were so damp that they contained numerous crustacea swarming if not actually swimming about the nests. They did not appear to be favourable habitats for fleas. Most of the fleas collected were evidently teneral specimens that suffered badly from overtreatment with caustic preparatory to mounting. The few others, including the types herein described, yielded good preparations.

Mioctenopsylla arctica arctica Rothschild

(Figs. 1, 4, a-b)

Mioctenopsylla arctica Rothschild, 1922, pp. 4-9; 5 figs. Jordan, 1932, p. 118 [sank *Boreopsyllus hadweni* (Ewing) as a synonym]. Kemner, 1938, pp. 104-106.

The species was fully described by Rothschild. However, the following points should be noted for comparison with *M. arctica hadweni*.

Male

Fixed process (Fig. 1, P) broadly expanded apically, even more broadly in some individuals than the example illustrated, according to Mr. Smit, who kindly provided sketches from four paratypes. Movable process (F) with a prominent process on the posterior margin, on which is situated a long, pigmented spiniform. A longish seta inserted at about the midpoint of the apical margin of F.

Female

The lobe of sternum VII rounded, but relatively narrow (Fig. 4, a-b); the sinus deep and broad.

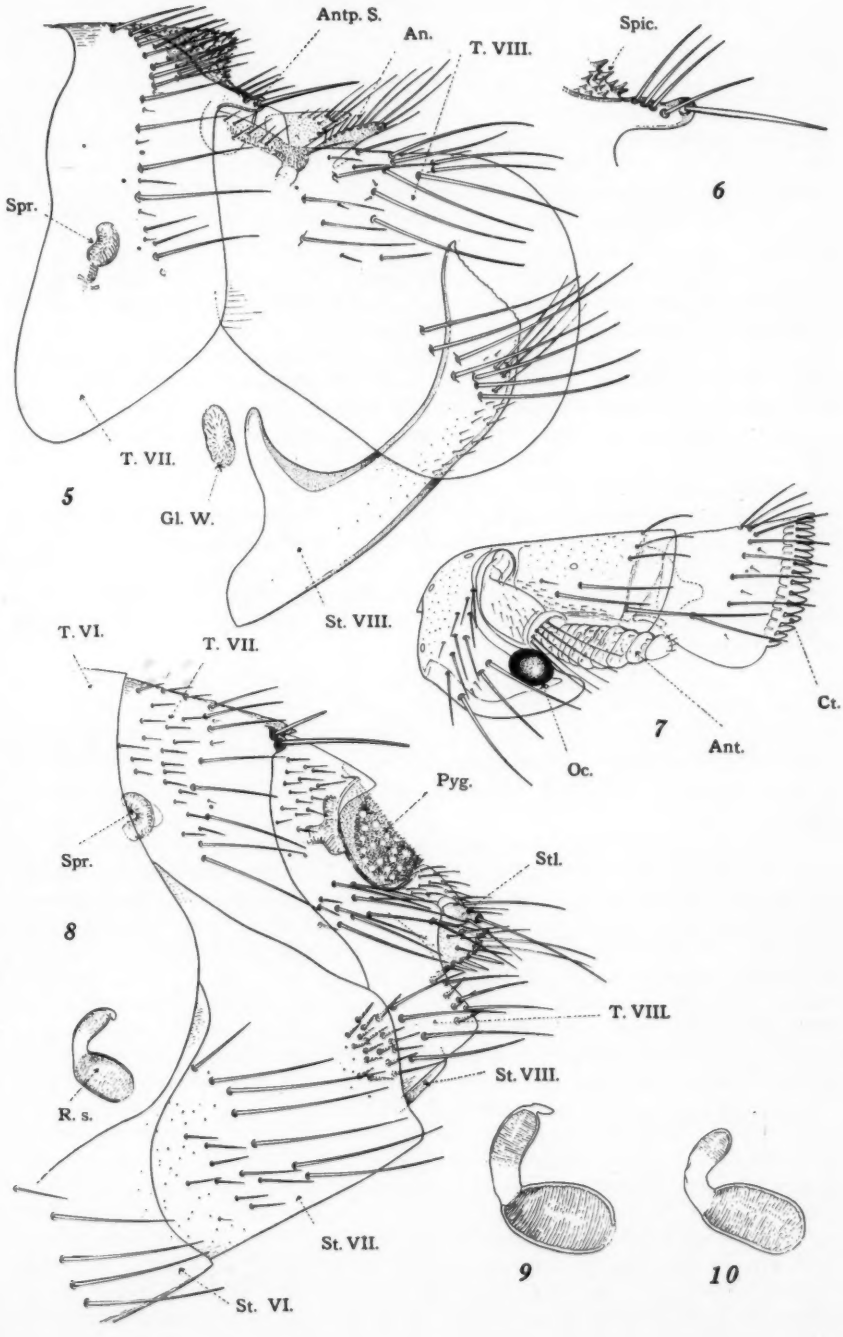
According to Rothschild, the type series of 20 ♂ ♂ and 39 ♀ ♀ exhibited considerable variation in size.The lengths of unmounted specimens were given as: ♂, 2.2-3.0 mm.; ♀, 2.4-3.4 mm.

Mioctenopsylla arctica hadweni (Ewing), new status

(Figs. 2, 4, c-e, 10)

Amphipsylla hadweni Ewing, 1927, pp. 89-90.
Boreopsyllus hadweni, Ewing, 1929, pp. 201-202.
Mioctenopsylla arctica, Ewing and Fox, 1943, p. 44; fig. 5, B.

Figs. 5-10. *Mioctenopsylla* spp. 5, *M. traubi*, n. sp., terminal abdominal segments of male (holotype). 6, *M. traubi*, detail of antepygidial setae of male. 7, *M. traubi*, head and pronotum of male. 8, *M. traubi*, terminal abdominal segments of female (allotype). 9, *M. traubi*, detail of spermatheca. 10, *M. arctica hadweni*, detail of spermatheca (St. Paul Is., Alaska).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Distinguishable from *M. a. arctica* by the genitalia, particularly those of the male.

Male

Fixed process slightly expanded apically (Fig. 2); somewhat variable in this respect, but apparently never attaining the breadth of that of *M. a. arctica.* Movable process proportionately longer, and with apical seta somewhat shorter than that of *M. a. arctica* and inserted anterad of mid-point of apical margin. Protuberance bearing a long spiniform usually not so pronounced as that of *M. a. arctica,* although attaining this degree of prominence in a few individuals.

Female

Generally with the lobe of sternum VII (Fig. 4, c-e) somewhat broader, and the sinus somewhat narrower, than in *M. a. arctica,* although some specimens would probably be inseparable.

As with *M. a. arctica,* there is considerable variation in size and apparently in degree of pigmentation. A few of the mounted specimens are dark brown, but most, obviously teneral specimens, are pale yellow.

Size (mounted specimens): ♂, average 2.75 mm. (2.1-3.2); ♀, average 2.7 mm. (2.3-3.3).

Material Examined

Puffin Island, Alaska, August 6, 1920, ex *Xema sabinei,* S. Hadwen, 1 ♀ [same lot as types of "*Amphipsylla hadweni*"]. St. Paul Island, Alaska, August 24, 1951, ex kittiwake nest, 55 ♂ ♂, 83 ♀ ♀, William L. Jellison and O. Wilford Olsen [A.P. 29819, Rocky Mountain Laboratory]. St. Paul Island, Alaska, September 1, 1951, ex kittiwake nest, 2 ♂ ♂, 1 ♀, William L. Jellison and O. Wilford Olsen [A.P. 29789].

***Mioctenopsylla traubi* new species**

(Figs. 3, 4, f-g, 5-9)

Larger than *M. arctica,* more setose, and with strongly characterized genitalia. Dark brown in colour. Details of head and thorax similar, but pronotal comb of about 16 spines per side (Fig. 7) in each sex, rather than 13, as in *M. arctica.*

Male

Strongly developed apical spinelets on the margins of the first four abdominal terga, the posterior flange of each tergum, above and below the spinelets, extending distad for the length of the spinelets. The major row of setae on each anterior abdominal tergum curving sharply anterad above a point near the apical spinelets, as in *M. arctica.* The dorsal posterior margins of the terga moderately denticulate as in *M. arctica* except that of tergum VII, which has an extensive area armed with numerous, conspicuous, cone-like spicules (Figs. 5-6). The antepygidial setae most unusual; a single long seta inserted at the apex of a long process, and a row of three or four strong setae extending dorsally along the length of the process (Fig. 6). Tergum VIII broadly rounded, and armed with a number of long setae dorsolaterally and ventrolaterally (Fig. 5). Sternum VIII, which in *M. arctica* tapers apically and is armed with a dorsal and a posterior membranous appendage, broad for its entire length and terminating abruptly in a minutely scalloped margin, and lacking membranous appendages. About four long setae disposed ventroapically, and a thin scattering of fine hairs occurring along the ventral surface. Fixed process of clasper short and thumb-like (Fig. 3). Movable process much larger than that of *M. arctica,* and somewhat differently shaped. The apical seta near the first blunt spiniform rather than in the middle of the apical margin (*M. a. arctica*) or in an anterior position (*M. a. hadweni*). The outer surface of the movable process with a number of

longitudinal ridges, and the inner surface beset with hundreds of tiny setae, neither condition occurring in *M. arctica.* Two long acetabular setae. Sternum IX with dorsal arm curving strongly backward; ventral arm with proximal and distal lobes somewhat deeper than those of *M. arctica,* but with similar armature.

Female

Details of head essentially as in the male, except for the usual sexual differences.

Anterior abdominal terga (as in *M. arctica*) without a strong anterior deflection of the major row of setae above the apical spinelets as in the male.

Tergum VII with only a moderately denticulate dorsal margin, and with "normal" antepygidial setae, a long and a short one on each side (Fig. 8). Posterior margins of sterna II-VI strongly incurved on each side, not relatively straight as in *M. arctica.* Sternum VII lacking a pronounced sinus (as in *M. arctica*) but with a broadly rounded margin, slightly concave ventrally, and with a hook-like process on one example (Fig. 4, g). Tergum VIII with about 15 short setae dorsolaterally; about seven long and a few short setae grouped laterally, below the stigma and sensilium; and about five long setae grouped ventrolaterally, in addition to about 15 shorter ones, most of which are overlapped by the margin of sternum VII. On the posterior margin of tergum VIII about three long setae, and, mesally, three or four short, stout setae. The anal stylet somewhat longer than that of *M. arctica,* and bearing a long apical seta and two shorter, subapical ones. The spermatheca larger than that of *M. arctica* (Figs. 9, 10), and with the head and tail of approximately equal length. A strong apical papilla on the tail; this structure smaller, or sometimes absent, in *M. arctica* (Fig. 10).

Size (mounted specimens): ♂, 4 mm.; ♀, 4 mm.

Holotype.— ♂, St. Paul Island, Pribilof Islands, Alaska, September 1, 1951, collected from the nest of a kittiwake, *Rissa* sp., by William L. Jellison and O. Wilford Olsen; deposited in the Collection of the National Microbiological Institute, Rocky Mountain Laboratory, Hamilton, Montana.

Allotype.— ♀, same data, Rocky Mountain Laboratory, Hamilton, Montana.

Paratype.—1 ♀, same data, Canadian National Collection, Ottawa, Canada.

It gives us great pleasure to associate the name of Colonel Robert Traub with this interesting species in recognition of his outstanding contributions to siphonapterology.

Abbreviations Used in Illustrations

An.—anus; Ant.—antenna; Antp.S.—antepygidial setae; Ct.—pronotal ctenidium; F.—movable process of clasper; Gl.W.—gland of Wagner; M.—manubrium of clasper; Oc.—eye; P.—Fixed process of clasper; Pyg.—sensilium (=pygidium); R.s.—spermatheca; Spic.—denticulate area of tergum VII; Spr.—spiracle; St.—abdominal sternum; Stl.—anal stylet; T.—abdominal tergum.

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A Device for Capturing Adult Insects in Rearing Containers and Cages[1]

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The successful transfer of adult insects from jars or cages to killing bottles or other cages is at best tedious and often difficult. The device illustrated in the accompanying plate was designed to facilitate this work. It has been tested in the insectary at Indian Head throughout one season with very satisfactory results. The model described and illustrated (Fig. 1) is a convenient size for use in transferring insects from small jars.

The body or container is shaped from a rectangular piece of celluloid, allowance being made for the overlapping joint, and cut to provide a lid stop, one-sixteenth inch in height, at the top of the cylinder. The cylinder may be formed around the end of a conveniently sized vial. The overlapping ends are secured with any acetate cement and held in place with elastic until the cement hardens. A circular piece of celluloid is then cemented to the bottom of the cylinder. The end of a celluloid collecting vial or plastic prescription tube may be readily adapted as a satisfactory substitute. The handle is a piece of masonite (or hardwood) shaped at one end to fit the curvature of the container and cemented to it smooth side up.

The lid is made of celluloid and is pear-shaped in general outline. The wide end fits tightly against the inside of the lid stop on the container. A small portion of the narrow end is cut off at right angles to the long axis of the piece, to facilitate fitting the lid on the lid handle. The lid handle is a piece of masonite having a narrow slot extending from one end down its centre. The surface on the closed end of this piece is recessed on its smooth side to accommodate the thickness of the lid. The lid is secured with cement in the position shown with the wide end extended past the handle part. Common pins, fitted with small circular pieces of celluloid and cut the required length, serve as guide and retaining pins; wide-headed furniture nails make a satisfactory substitute. A small piece of sandpaper cemented to the lid handle allows greater ease of manipulation.

The device is completed by placing the lid assembly in the closed position on the body and handle of the trap. The guide pins are inserted through the slot and into the handle at points which will allow the lid to be opened and closed. (Fig. 2).

The advantages of this device are as follows:—

(1) It facilitates the capture and transfer of insects in rearing work.
(2) Live insects, particularly small, fragile Lepidoptera, may be handled with minimum injury.
(3) It is light and easy to manipulate.
(4) It is low in cost and easy to construct.
(5) It allows a view of the trapped insect.
(6) It may be adapted for use in all types of rearing jars and cages.

The model illustrated is of light construction and is not intended to withstand rough usage. Larger and heavier models may be made on a similar pattern with wooden handles for additional strength.

[1]Contribution No. 56, Division of Forest Biology, Science Service, Department of Agriculture, Ottawa, Canada.

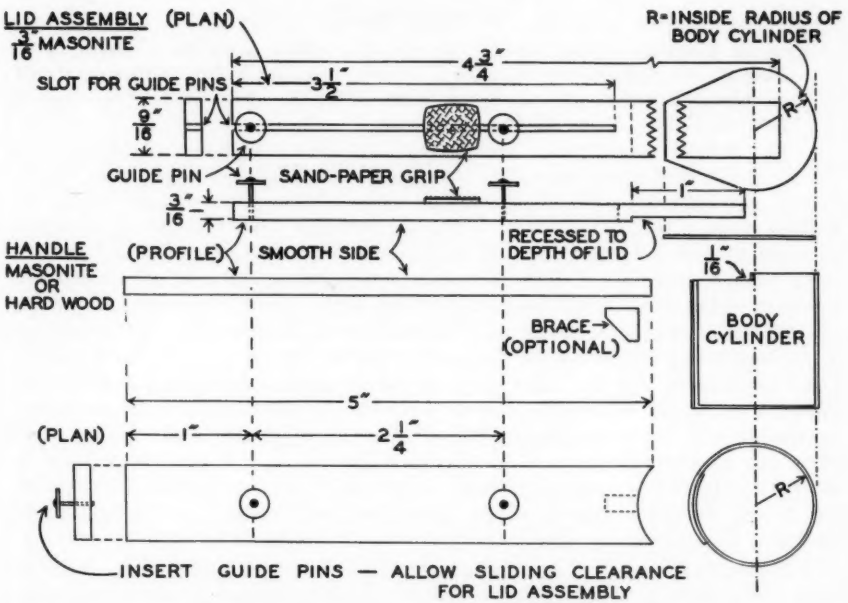

Fig. 1. Plan showing construction details of the device for capturing adult insects. From original sketch by Wm. Haliburton.

Fig. 2. The device in operation. Photograph by F. L. Garraway.

Book Review

***A Generic Revision of the family Agromyzidae (Diptera) with a catalogue of New World Species*, by Kenneth E. Frick. University of California Publications in Entomology, vol. 8, no. 8, pp. 339-452. 34 text figures. Issued Jan. 4, 1952. Price $1.25.**

The state of neglect into which much of the classification of Diptera has fallen on this continent, due to the shortage of specialists and from other causes, is well exemplified by the Agromyzidae. Our classification of this family has needed revision for over 30 years. The arrangement proposed by the Viennese dipterist Friedrich Hendel in 1920 and subsequently consolidated and amplified in his great monograph of 1931-36 had been accepted at once by most European students. His work demonstrated that the large genus *Agromyza* could be divided into a number of genera and subgenera on reliable adult characters, the groupings being supported by biological evidence so far as this was available. His classification, for the most part, appeared to be admirably suited to the Nearctic fauna and its failure to appear earlier in our literature must be attributed to the general conditions mentioned above. Its rejection could hardly have been due to the influence of Malloch, for, although this worker refused to ascribe to Hendel's groups more than subgeneric value, his descriptive work on the North American species of Agromyzidae was virtually completed before 1920 and his opinions on Hendel's work occur in writings on other faunas.

Hendel had made no use of male genitalic characters, and it was therefore clear that a study of these organs might provide an opportunity to test the value of his arrangement in interpreting relationships as opposed to its mere convenience as a taxonomic framework on which to hang descriptions of species. It is this opportunity that has been seized upon by Dr. Frick, and although the scope of his work is not confined to the mere putting on trial of Hendel's classification, this is the most important part of it from the standpoint of the systematist and it is gratifying to this reviewer to be able to report that Hendel's genera and subgenera emerge from the ordeal virtually intact.

The arrangement of the systematic treatment, which forms the main part of Dr. Frick's paper, is very good. Historical and other aspects of relationships, both above and below the family level, are discussed at some length. The treacherous subject of phylogeny is treated with commendable reticence, and although the author has been unable to resist the temptation to present a phylogenetic tree for the genera, this is qualified by an explanation of at least some of the difficulties involved. Three generic and subgeneric keys to the adults are provided, one being based on male genitalia. There is also a key to the larvae of North American genera. The generic diagnoses, which deal with both adult and larval forms, are excellent and the biological and other notes following each diagnosis are among the most useful features of the paper. At the end of each generic treatment is a catalogue of the New World species which naturally contains a very high percentage of new combinations. The latter information is usefully consolidated later in a reference list giving the old and new combinations in parallel columns. The paper closes with the most complete systematic bibliography of the family yet to appear—305 titles. The illustrations are mainly concerned with adult and larval morphology, but some drawings illustrating wing venation in different genera are also included. To sum up, Dr. Frick has provided a sound basis for the extensive work on species biology and classification that still remains to be done. Whether the Hendel classification will prove adequate to embrace a world-wide fauna still remains to be seen, but Dr. Frick appears to believe that it will.

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